Adverse Selection in Credit Markets and Regressive Profit Taxation

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Abstract

In many countries, taxes on businesses are less progressive than labor income taxes. This paper provides a justification for this pattern based on adverse selection that entrepreneurs face in credit markets. Individuals choose between becoming entrepreneurs or workers and differ in their skill in both of these occupations. I find that endogenous cross-subsidization in the credit market equilibrium results in excessive (insufficient) entry of low-skilled (high-skilled) agents into entrepreneurship. This gives rise to a corrective role for differential taxation of entrepreneurial profits and labor income. In particular, a profit tax that is regressive relative to taxes on labor income restores the efficient occupational choice.

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1 Introduction

In most countries, taxes on entrepreneurs and businesses, such as the corporate income tax, are less progressive than labor income taxes in the sense that they are typically characterized by flat rather than increasing marginal tax rates. This paper proposes a framework in which such a pattern arises as an optimal policy response to frictions that entrepreneurs face in credit markets. The argument is developed in a model in which individuals can choose between entrepreneurship and paid employment as workers and have private information about their ability in both of the two occupations. In order to set up a firm, entrepreneurs have to borrow funds in competitive credit markets that are affected by adverse selection.\(^1\) Whenever there is cross-subsidization between high and low quality borrowers, this provides excessive incentives for low skilled individuals to enter entrepreneurship, but insufficient incentives for high ability agents. I show that this occupational misallocation can be removed by a profit tax that is regressive relative to labor income taxes, thus counteracting the cross-subsidization in the credit market equilibrium. Notably, this pattern of tax policy can be justified on efficiency grounds even without a redistributive or revenue motive for taxation.

The fact that adverse selection can induce the wrong mix of individuals in entrepreneurship and paid employment, rather than just an inefficient overall share of entrepreneurs in the economy, is driven by multidimensional heterogeneity. The existing literature, going back to the seminal papers by Stiglitz and Weiss (1976) and De Meza and Webb (1987), has instead focused on settings where a one-dimensional ability type drives occupational choice. In this case, credit market imperfections induce either a too low or a too high number of agents to become entrepreneurs, depending on whether privately known ability affects the mean or the riskiness of entrepreneurial returns. This calls for either a lump-sum subsidy or tax on entrepreneurship (or bank profits) to restore efficiency, but is unable to explain why profit taxes should be less progressive than labor income taxes.

By contrast, I consider a more natural setting in which individuals differ in both their ability as entrepreneurs and workers, and the two dimensions of private information are not necessarily perfectly correlated. In this case, adverse selection in credit markets can distort occupational choice even if the equilibrium level of overall entrepreneurial activity is at the efficient level. This is because the composition of agents in entrepreneurship is inefficient, with too many and too few entrepreneurs at the same time. Whereas lump-sum taxes or subsidies on entrepreneurship are unable to correct this misallocation, I

\(^1\)See e.g. Evans and Leighton (1989), Hurst and Lusardi (2004) and De Nardi, Doctor, and Krane (2007) for evidence on the importance of borrowing frictions for entrepreneurship.
demonstrate that regressive profit taxes are a more flexible corrective instrument that not only affects the overall level but also the ability mix of agents in the two occupations.

Formally, private heterogeneity is captured in the model by a type vector \((\theta, \phi)\), where \(\theta\) denotes an individual’s entrepreneurial skill and \(\phi\) the skill as a worker. Entrepreneurial profits \(\pi\) are risky and distributed according to some cdf \(H(\pi|\theta)\), where higher \(\theta\) leads to better profit distributions. On the other hand, if an individual chooses to become a worker, her payoff is deterministic and proportional to her skill \(\phi\). This structure generates some frontier \(\tilde{\phi}(\theta)\) that determines occupational choice, i.e. the set of types who are just indifferent between becoming entrepreneurs or workers. All types with \(\phi \leq \tilde{\phi}(\theta)\) become entrepreneurs and all the others workers.

I start with characterizing credit market equilibria in this economy. Competitive banks offer the funds needed by entrepreneurs to set up a firm in exchange for repayment schedules \(R_\theta(\pi)\). Theorem 1 shows that, under some conditions on the joint distribution of \(\theta\) and \(\phi\) and feasible repayment schemes, the equilibrium involves only a single debt contract \(R(\pi) = \min\{\pi, z\}\) being offered to all types of entrepreneurial ability. This generalizes the results from the financial contracting literature in settings with moral hazard or one-dimensional heterogeneity, in particular Innes (1990, 1993), to the present setting with multidimensional heterogeneity. The complication here is that the critical values for occupational choice \(\tilde{\phi}(\theta)\) now depend on the offered credit contracts. Hence banks must take into account which types get attracted into entrepreneurship and thus the credit market when they offer deviating contracts, rather than just which types get attracted out the credit contracts offered by other banks.

As a result of the cross-subsidization between high and low quality borrowers in the pooling equilibrium, occupational choice is distorted compared to the efficient allocation in the sense that the equilibrium frontier \(\tilde{\phi}(\theta)\) is a rotation of the efficient one: there are too many low-\(\theta\) and too few high-\(\theta\) entrepreneurs in equilibrium, i.e. \(\tilde{\phi}(\theta)\) is too flat. Since the credit market imperfection therefore does not discourage (or encourage) entry into entrepreneurship across the board, lump-sum policy instruments suggested in the existing literature are unable to address it. Proposition 1 demonstrates, however, that a regressive profit tax, which in expectation subsidizes high-skilled entrepreneurs and taxes low-skilled ones, can be designed so as to counteract the effects of cross-subsidization in the credit market and restore the efficient occupational choice. This points out the role of profit taxation as a more targeted policy instrument that is able to control the composition of entrepreneurship rather than just its overall level.

I finally extend the model to allow for endogenous labor supply and demand and thus taxes on workers in addition to entrepreneurs. In this case, progressive taxation of
labor income, together with a flat profit tax, is an alternative policy tool to implement efficient occupational choice. Rather than directly counteracting cross-subsidization in credit markets, it introduces the symmetric cross-subsidization among workers. In fact, Proposition 2 shows that there exists a continuum of implementations, ranging from the one extreme of a regressive profit tax together with a flat tax on labor income, to the other extreme of a flat tax on profits and a progressive labor income tax. What matters in all of these implementations is that entrepreneurial taxes are regressive relative to the taxes on workers. As mentioned at the beginning, this indeed describes a pattern that can be frequently observed in practice, since business taxes are indeed less progressive than labor taxes in most countries.

The present paper is related to an extensive literature on the role of government interventions in credit markets with adverse selection. This research has focused on models with one-dimensional heterogeneity and derived contrasting results depending on whether entrepreneurial ventures differ in terms of their risk profile or their expected returns. The most prominent example of the former case is Stiglitz and Weiss (1976), who point out the possibility of credit rationing and therefore an inefficiently low number of entrepreneurs in equilibrium. In contrast, De Meza and Webb (1987) have developed a model corresponding to the second case and shown that excessive entry into entrepreneurship can result if the outside option is a fixed safe investment. In this case, the appropriate policy is to tax rather than subsidize entrepreneurship. However, none of these papers addresses the role of multidimensional heterogeneity for equilibrium efficiency nor the optimal progressivity of profit taxes.

More closely related are the more recent contributions by Parker (2003) and Ghatak, Morelli, and Sjöström (2007). The present paper shares their approach of viewing the outside option of entrepreneurs as paid employment rather than a safe investment and therefore of exploring the role of tax policy as a means to affect occupational choice. However, the key difference is that both papers stick to settings with one-dimensional heterogeneity. Ghatak, Morelli, and Sjöström (2007) consider a two-type model and assume that $\theta$ and $\phi$ are perfectly correlated. With pooling in credit markets, all high-$\theta$ types and an inefficiently high share of low-$\theta$ types become entrepreneurs, whereas the remaining low-$\theta$ types become workers. As in De Meza and Webb (1987), a lump-sum tax on entrepreneurs is therefore optimal. I show that this no longer holds when abilities for the two occupations are not perfectly correlated, since this generates an occupational misallocation with too many and too few entrepreneurs simultaneously. The optimal policy therefore must discourage entry into entrepreneurship for some types, but encourage it for other types.

Parker (2003) also considers an economy where $\phi$ is a function of $\theta$, but allows for
multiple crossings in the relationship so that it no longer necessarily is the case that all high ability types become entrepreneurs and the others workers. However, even if there are multiple intervals in the relationship between abilities and occupational choice, there always exists a one-to-one mapping in the sense that different occupations have income distributions with non-overlapping supports. Moreover, the tax policies proposed in his contribution crucially rely on this property. The present paper addresses the difficulties that arise in the absence of such a one-to-one-mapping, which Parker (2003) speculates about. With two-dimensional heterogeneity, there are both entrepreneurs and workers at any ability and thus income level. Despite that, it turns out that it is possible to transparently characterize the occupational misallocation and tax policies that correct it. In particular, none of the above papers derive the (relative) regressivity of profit taxes as an optimal policy response to the distortions from credit market frictions.

The structure of the paper is as follows. Section 2 introduces the baseline model with two-dimensional heterogeneity. Section 3 characterizes the credit market equilibrium without taxes. The main result is Theorem 1, which implies cross-subsidization between borrowers of different qualities in equilibrium. Section 4 analyzes the effects of this cross-subsidization on the equilibrium occupational choice and constructs a regressive profit tax system that eliminates this occupational misallocation (Proposition 1). Section 5 provides a numerical example and Section 6 extends the baseline model to allow for labor income taxes. Proposition 2 shows that what matters in this more general framework is that profit taxes are regressive relative to labor income taxes. Finally, Section 7 concludes. The proof of Theorem 1 is relegated to the appendix.

2 The Model

I consider a unit mass of heterogeneous individuals who are characterized by a two-dimensional type vector \((\theta, \phi) \in \Theta \times \Phi \equiv [\theta, \bar{\theta}] \times [\phi, \bar{\phi}],\) where \(\theta\) will be interpreted as an individual’s skill as an entrepreneur and \(\phi\) as an individual’s skill as a worker, as explained in more detail below. \(F(\theta)\) is the cumulative distribution function of \(\theta\) and \(G_\theta(\phi)\) the cumulative distribution function of \(\phi\) conditional on \(\theta\), both assumed to allow for density functions \(f(\theta)\) and \(g_\theta(\phi)\). Both \(\theta\) and \(\phi\) are an individual’s private information.

Agents can choose between two occupations: They can become a worker, in which case they obtain the payoff \(\phi\) according to the second dimension of their skill type. Alternatively, an agent may select to become an entrepreneur. To set up a firm, each entrepreneur has to make a fixed investment \(I\). Agents are born without wealth and hence have to borrow these funds from banks in a competitive credit market. Entrepreneurs
produce stochastic profits $\pi$ according to some cdf $H(\pi|\theta)$ that depends on their entrepreneurial skill $\theta$. In particular, I assume that $H(\pi|\theta) \succeq_{\text{MLRP}} H(\pi|\theta')$ for $\theta > \theta'$, i.e. a higher skilled entrepreneur has a distribution of $\pi$ that is better in the sense of the monotone likelihood ratio property (MLRP). $H(\pi|\theta)$ has support $\Pi \equiv [\underline{\pi}, \bar{\pi}]$ for all $\theta$ such that

$$\underline{\pi} < I < \bar{\pi} \quad \text{and} \quad \phi \leq \int_{\Pi} \pi dH(\pi|\theta) - I < \bar{\phi} \quad \forall \theta \in \Theta.$$ 

The first assumption rules out trivial credit market equilibria where entrepreneurs can always or never repay the investment outlays $I$, independent of their profit realization. The second implies that, for each $\theta$, there exist $\phi$-types for who it is efficient to become entrepreneurs and others for who efficiency requires them to be workers. An entrepreneur’s realized profits $\pi$ are publicly observable.

There is a large number of risk-neutral banks, offering credit contracts that supply funding $I$ in return for a repayment schedule $R_\theta(\pi)$.\(^2\) The expected utility of an entrepreneur of ability type $\theta$ from such a contract is then

$$\int_{\Pi} [\pi - R_\theta(\pi)] dH(\pi|\theta).$$

For a given credit contract, an individual of skill type $(\theta, \phi)$ decides to enter entrepreneurship if and only if

$$\int_{\Pi} [\pi - R_\theta(\pi)] dH(\pi|\theta) \geq \phi$$

and becomes a worker otherwise. I can therefore characterize the occupational choice decision of all individuals by the critical values

$$\hat{\phi}(\theta) \equiv \max \left\{ \phi, \min \left\{ \bar{\phi}, \int_{\Pi} [\pi - R_\theta(\pi)] dH(\pi|\theta) \right\} \right\}$$

such that all $(\theta, \phi)$ with $\phi \leq \hat{\phi}(\theta)$ become entrepreneurs and all the others workers. This also makes clear that occupational choice depends on the (endogenous) credit market equilibrium $\{R_\theta(\pi)\}$, a key force underlying the results in the following. For the remainder of the paper, I assume that the support $[\underline{\phi}, \bar{\phi}]$ is sufficiently wide that the critical value for occupational choice $\hat{\phi}(\theta)$ is given by an interior value in $(\phi, \bar{\phi})$ in the relevant equilibria.

As a result of two-dimensional heterogeneity in both skill dimensions, there will not

\(^2\)I introduce the index $\theta$ even though $\theta$ is private information since, in a separating equilibrium, banks may offer different credit contracts to entrepreneurs of different ability levels $\theta$. Of course, any such assignment has to be incentive compatible, as specified below. Moreover, note that it is impossible to screen entrepreneurs based on their $\phi$-type.
be a perfect ranking between occupational choice and (expected) payoffs: For any given \( \theta \), there are individuals who enter entrepreneurship and others who become workers due to their different \( \phi \)-type. This is an empirically attractive implication of the present specification and in contrast to models where occupational choice is only based on one dimension of heterogeneity. In that case, it is typically assumed that one occupation rewards ability relatively more than the other. Then there exists a critical skill level such that higher skilled agents select into the high-reward occupation, and lower-ability agents into the other. This results in income distributions for the two occupations that occupy non-overlapping intervals.

3 Equilibrium in the Credit Market

I next define and characterize credit market equilibria in the economy introduced in the preceding section.

**Definition 1.** A credit market equilibrium is a set of contracts \( \{ R_\theta(\pi) \} \) such that

\[
(i) \quad \int_{\Pi} (\pi - R_\theta(\pi)) \, dH(\pi|\theta) \geq \int_{\Pi} (\pi - R_{\theta'}(\pi)) \, dH(\pi|\theta) \quad \forall \theta, \theta' \in \Theta,
\]

\[
(ii) \quad \int_{\Theta} G_\theta(\tilde{\phi}(\theta)) \left[ \int_{\Pi} R_\theta(\pi) \, dH(\pi|\theta) - I \right] \, dF(\theta) \geq 0
\]

with

\[
\tilde{\phi}(\theta) = \int_{\Pi} (\pi - R_\theta(\pi)) \, dH(\pi|\theta) \quad \forall \theta \in \Theta, \quad \text{and}
\]

(iii) there exists no other set of contracts \( \{ \tilde{R}_\theta(\pi) \} \) that earns strictly positive profits when offered in addition to \( \{ R_\theta(\pi) \} \) and all individuals select their preferred occupation and preferred contract from \( \{ \tilde{R}_\theta(\pi) \} \cup \{ R_\theta(\pi) \} \).

Condition (1) is the set of incentive constraints, which require that each entrepreneur is willing to select the credit contract \( R_\theta(\pi) \) intended for her. Constraint (2) makes sure that the set of equilibrium credit contracts make non-negative profits in aggregate when taken up by the agents who select into entrepreneurship, as given by the critical cost values \( \tilde{\phi}(\theta) \) for all \( \theta \in \Theta \). Finally, the last part of the definition rules out profitable sets of deviating contract offers. Note that, although the structure of this definition is similar to Rothschild

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 Following Innes (1993), I restrict attention to contracts $R_\theta(\pi)$ that satisfy the following two properties: First, $0 \leq R_\theta(\pi) \leq \pi$ for all $\theta \in \Theta$ and $\pi \in \Pi$, which is a standard limited liability constraint. Second, $R_\theta(\pi)$ is non-decreasing in $\pi$ so that, when the entrepreneur earns higher profits, the repayment received by the bank $R_\theta(\pi)$ is also higher. This monotonicity constraint has been a standard assumption in the financial contracting literature since Innes (1990) and Nachman and Noe (1994). It generates more realistic equilibrium contracts by smoothing sharp discontinuities in repayment schedules.\(^4\)

De Meza and Webb (1987) and Innes (1990, 1993) have characterized credit market equilibria under such assumptions in models with moral hazard or one-dimensional private heterogeneity, as captured by $\theta$. As the next theorem shows, their results can be generalized to the present framework with two-dimensional heterogeneity under the following assumption on the joint distribution of $\theta$ and $\phi$.

**Assumption 1.** $\theta$ and $\phi$ are independent and $g(\phi)$ is non-increasing.

While these assumptions are restrictive, they ensure that the two-dimensional screening problem that banks face when offering credit contracts remains tractable and the equilibrium takes the particularly simple form of a single pooling credit contract.

**Theorem 1.** Under Assumption 1, the credit market equilibrium is such that only the single contract $R_{z^*}(\pi) = \min\{\pi, z^*\}$ is offered and $z^*$ solves

$$\int_\Theta G(\tilde{\phi}_{z^*}(\theta)) \left[ \int_\Pi \min\{\pi, z^*\}dH(\pi|\theta) - I \right] dF(\theta) = 0$$

with

$$\tilde{\phi}_{z^*}(\theta) = \int_\Pi (\pi - \min\{\pi, z^*\}) dH(\pi|\theta) \quad \forall \theta \in \Theta.$$  

**Proof.** See Appendix A. \qedsymbol

Theorem 1 shows first that an equilibrium always exists. Second, it is such that entrepreneurs of all ability types are pooled in the same contract. Both of these results are very different from the canonical competitive screening model by Rothschild and Stiglitz (1976). In particular, in their model, even when restricting each bank to offer a single contract only, an equilibrium may fail to exist, and it can never take the pooling form. Moreover, an equilibrium as specified in Definition 1, allowing for cross-subsidization, would

\(^4\)See Chapters 3.6 and 6.6 in Tirole (2006) for formal justifications based on hidden trades. In addition, it is straightforward to see that whenever $\pi$ has only two possible realizations, any repayment scheme that guarantees the bank non-negative profits in equilibrium must be weakly increasing in $\pi$. 

and Stiglitz (1976), it is considerably more general by letting banks offer sets of contracts, thus allowing for cross-subsidization between different contracts in equilibrium.
fail to exist under an even larger set of parameters in the Rothschild-Stiglitz model, as shown by Wilson (1977) and Miyazaki (1977). However, the present model is quite different due to risk-neutrality of all parties, the assumptions on feasible repayment schemes and endogenous entry into the credit market.

The second key result in the theorem is that the equilibrium credit contract takes the very simple form of a debt contract: It specifies a fixed repayment level $z^*$, which the entrepreneur has to return to the bank whenever she can, i.e. whenever $\pi \geq z^*$. Otherwise, the firm goes bankrupt, and the entire amount of profits goes to the bank, with the entrepreneur hitting her liability limit and thus being left with zero consumption. This results in the contract $R_{z^*}(\pi) = \min\{\pi, z^*\}$, where $z^*$ is such that the banks’ expected profit is zero given the set of agents who enter the credit market when anticipating the equilibrium contract $R_{z^*}(\pi)$. The intuition for this debt contracting result is as in the models with one-dimensional heterogeneity, such as Innes (1993): By the monotone likelihood ratio property, low-skill entrepreneurs have a larger probability weight in low-profit states. Among all contracts satisfying the monotonicity constraint, debt contracts in turn are the ones that put the maximal repayment weight in these low-profit states. As a result, debt contracts are least attractive to low-skill borrowers, and hence any set of deviation contracts that do not take the debt contract form would attract a lower quality borrower pool and generate lower profits for banks.

The result in Theorem 1 goes through even with two-dimensional heterogeneity for two reasons. First, the second dimension of the skill type $\phi$ does not affect preferences over different credit contracts. In other words, an individual’s skill as a worker $\phi$ only affects her occupational choice, but not which credit contract she finds attractive given that she chooses to be an entrepreneur. However, the distribution $G_{\theta}(\phi)$ still matters for bank profits, since it determines how many agents of entrepreneurial skill $\theta$ choose to become entrepreneurs, and also how many of them are attracted into credit markets by a deviating contract.

The proof of Theorem 1 therefore involves demonstrating that, under the conditions in Assumption 1, there still does not exist a profitable deviation for any bank from the pooling debt contract even though the number of entrepreneurs of skill $\theta$ who demand credit contracts, given by $G_{\theta}(\hat{\phi}_{z^*}(\theta)) f(\theta)$, is now an endogenous and smooth function of $\theta$, in contrast the models with one-dimensional heterogeneity. Indeed, if $\phi$ is the same for all individuals, so that $G_{\theta}(\phi)$ converges to some degenerate Dirac distribution, then there exists a critical value $\theta^*$ such that all individuals with $\theta \leq \theta^*$ become workers and all others entrepreneurs, i.e. $G_{\theta}(\hat{\phi}_{z^*}(\theta)) = 0 \forall \theta \leq \theta^*$ and $G_{\theta}(\hat{\phi}_{z^*}(\theta)) = 1$ otherwise. For the more general two-dimensional distributions considered here, Assumption 1 ensures
that $G_\theta(\tilde{\phi}_z(\theta))$ is still increasing in $\theta$ and any deviating contract attracts relatively more low-\theta agents into the credit market than high-\theta agents (see Lemmas 3 and 4 in Appendix A). Let me note that the conditions in Assumption 1 are sufficient, not necessary for the existence of the equilibrium in Theorem 1.

4 Occupational Choice and Entrepreneurial Tax Policy

4.1 Inefficiency of Occupational Choice

I now ask whether the no tax equilibrium in this economy involves the efficient occupational choice. In fact, efficiency would require that a type $(\theta, \phi)$ becomes an entrepreneur if and only if

$$\int_\Pi \pi dH(\pi|\theta) - I \geq \phi,$$

i.e. her expected profits minus the investment outlays exceed the payoff from being a worker $\phi$. This can be solved for the efficient critical cost value

$$\hat{\phi}_e(\theta) \equiv \int_\Pi \pi dH(\pi|\theta) - I \quad (5)$$

for any $\theta \in \Theta$. Then the following result is a corollary of Theorem 1:

**Corollary 1.** There exists a unique skill-type $\tilde{\theta}$ s.t. $\int_\Pi \min\{\pi, z^*\} dH(\pi|\tilde{\theta}) = I$ and

\[ \hat{\phi}_z(\theta) > \hat{\phi}_e(\theta) \quad \forall \theta < \tilde{\theta} \quad \text{and} \quad \hat{\phi}_z(\theta) < \hat{\phi}_e(\theta) \quad \forall \theta > \tilde{\theta}. \]

**Proof.** First, $\int_\Pi \min\{\pi, z^*\} dH(\pi|\theta)$ is increasing in $\theta$ by the monotone likelihood ratio property. Second, $\tilde{\theta}$ exists by the aggregate zero profit constraint (3). Third, by (4) and (5), $\hat{\phi}_e(\theta) < \hat{\phi}_z(\theta)$ if and only if $\int_\Pi \min\{\pi, z^*\} dH(\pi|\theta) \gtrless I$. \(\square\)

Since the credit market equilibrium is a pooling equilibrium, it involves cross-subsidization across entrepreneurs of different quality $\theta$. In particular, by the monotone likelihood ratio property, banks make higher profits with higher ability entrepreneurs, and thus by the zero profit condition (3), there exists some critical skill level $\tilde{\theta}$ such that banks make profits with all higher quality entrepreneurs and negative profits with all the others. But this cross-subsidization implies that, compared to the efficient occupational choice defined in (5), low skilled agents have too strong incentives to set up a firm, and too many high skill agents stay in the workforce. In other words, the credit market equilibrium generates occupational misallocation such that there is excessive entry of low ability types into entrepreneurship, but insufficient entry of high-skilled types. This can be seen most
easily by substituting the equilibrium zero profit condition (3) into equation (5), solving the former for \( I \):

\[
\tilde{\phi}_c(\theta) = \int_{\Pi} \pi dH(\pi|\theta) - \frac{\int_{\Theta} G(\tilde{\phi}_{z^*}(\theta)) \int_{\Pi} \min \{\pi, z^*\} dH(\pi|\theta)dF(\theta)}{\int_{\Theta} G(\tilde{\phi}_{z^*}(\theta))dF(\theta)}
\]

and comparing it with the equilibrium critical values for occupational choice in (4):

\[
\tilde{\phi}_{z^*}(\theta) = \int_{\Pi} \pi dH(\pi|\theta) - \int_{\Pi} \min \{\pi, z^*\} dH(\pi|\theta).
\]

Notably, this comparison clearly identifies the importance of cross-subsidization as the source of the inefficiency: If \( \Theta \) is singleton, for instance, then \( \tilde{\phi}_{z^*}(\theta) = \tilde{\phi}_c(\theta) \).

A special case of this misallocation obtains when \( \phi \) is the same for all agents, so that there only remains one-dimensional heterogeneity in ability. Then the equilibrium involves excessive entry into entrepreneurship, with too many low-skill types receiving funding in the credit market. This observation has been made first by De Meza and Webb (1987) in a model where agents choose between a safe investment and a risky project (entrepreneurship) with binary output, and extended to an occupational choice setting by Ghatak, Morelli, and Sjöström (2007).\(^5\) This extreme case is quite in contrast to the seminal analysis by Stiglitz and Weiss (1976), who emphasized credit rationing and thus insufficient entry into entrepreneurship in a model where entrepreneurs differ in the riskiness of their projects rather than expected returns.

The present model demonstrates that, with two-dimensional heterogeneity, the occupational inefficiency can take both forms simultaneously, as there are too many and too few entrepreneurs of different skill types. In fact, the overall level of entrepreneurship can no longer be considered to evaluate the efficiency or inefficiency of the equilibrium. The total share of entrepreneurs in equilibrium may be equal to the efficient level, i.e.

\[
\int_{\Theta} G(\tilde{\phi}_{z^*}(\theta))dF(\theta) = \int_{\Theta} G(\tilde{\phi}_c(\theta))dF(\theta),
\]

but the equilibrium occupational choice would still be inefficient because the wrong mix of individuals are in the two occupations. This will be further illustrated in the numerical example in Section 5. It also demonstrates that, most generally, if different occupations are affected by different degrees of cross-subsidization, this makes the equilibrium occu-

\(^5\)The latter in fact consider a two type model with \( \theta \in \{\theta_L, \theta_H\} \) and assume that the skill as an entrepreneur and a worker are perfectly correlated with \( \phi(\theta_H) < \phi(\theta_L) \). This effectively reduces heterogeneity to one dimension as well with the result that, in the relevant equilibria, all \( \theta_H \)-types and an inefficiently high share of the \( \theta_L \)-types become entrepreneurs.
pational choice decisions inefficient.

4.2 Regressive Profit Taxation

In the following, I show that there is a simple entrepreneurial tax policy that eliminates this occupational misallocation. Suppose the government introduces a (possibly non-linear) entrepreneurial profit tax $T(\pi)$, so that an entrepreneur’s after-tax profits are given by $\hat{\pi} \equiv \pi - T(\pi)$. Banks and entrepreneurs, taking the tax schedule $T(\pi)$ as given, then write contracts contingent on these after-tax profits $\hat{\pi}$, and I can define the resulting credit market equilibrium for any given tax policy just as in Definition 1, replacing $\pi$ by $\hat{\pi}$. Moreover, I keep assuming that contracts $R_\theta(\hat{\pi})$ must satisfy the limited liability constraint $0 \leq R_\theta(\hat{\pi}) \leq \hat{\pi}$ and the monotonicity constraint that $R_\theta(\hat{\pi})$ is non-decreasing in $\hat{\pi}$.

Under these conditions, it is known from Theorem 1 that the credit market equilibrium is a pooling equilibrium with only a debt contract being offered if the after-tax profits $\hat{\pi}$ satisfy the monotone likelihood ratio property with respect to $\theta$, so that $\hat{H}(\hat{\pi} | \theta) \succeq_{\text{MLRP}} \hat{H}(\hat{\pi} | \theta')$ for $\theta > \theta'$, where $\hat{H}(\hat{\pi} | \theta)$ is the cdf of after-tax profits for type $\theta$. The following lemma provides a condition on the tax schedule $T(\pi)$ for this to hold.

**Lemma 1.** Suppose $H(\pi | \theta) \succeq_{\text{MLRP}} H(\pi | \theta')$ for $\theta > \theta'$, $\theta, \theta' \in \Theta$, and $T(\pi)$ is such that $\hat{\pi} = \pi - T(\pi)$ is increasing. Then $\hat{H}(\hat{\pi} | \theta) \succeq_{\text{MLRP}} \hat{H}(\hat{\pi} | \theta')$.

**Proof.** Since $\hat{\pi} \equiv \Gamma(\pi) \equiv \pi - T(\pi)$ and $\Gamma(\pi)$ is increasing, the following relation between $\hat{H}(\hat{\pi} | \theta)$ and $H(\pi | \theta)$ is true:

$$\hat{H}(\Gamma(\pi) | \theta) = H(\pi | \theta) \quad \forall \pi \in \Pi, \theta \in \Theta$$

and equivalently

$$\hat{H}(\hat{\pi} | \theta) = H(\Gamma^{-1}(\hat{\pi}) | \theta) \quad \forall \hat{\pi} \in \hat{\Pi}, \theta \in \Theta.$$

Differentiating with respect to $\hat{\pi}$, I therefore obtain

$$\hat{h}(\hat{\pi} | \theta) = \frac{h(\Gamma^{-1}(\hat{\pi}) | \theta)}{\Gamma'(\Gamma^{-1}(\hat{\pi}))} \quad \forall \hat{\pi} \in \hat{\Pi}, \theta \in \Theta. \quad (6)$$

By assumption, $H(\pi | \theta)$ satisfies MLRP, which means that $h(\pi | \theta) / h(\pi | \theta')$ is increasing in $\pi$ for

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6The idea behind this is that the government has no superior ability to extract tax payments from a firm in case of bankruptcy compared to banks, so that must always hold that $\pi - T(\pi) - R(\pi) \geq 0$, where $R(\pi)$ is the repayment to the bank. In addition, when $T(\pi)$ is negative, it is assumed that banks can capture this transfer from the government in case of bankruptcy, so that $R(\pi) \leq \pi - T(\pi)$. In other words, tax payments are fully pledgeable.
\( \theta > \theta' \). Equation (6) yields

\[
\frac{\hat{h} (\hat{\pi} | \theta)}{\hat{h} (\hat{\pi} | \theta')} = \frac{h (\Gamma^{-1} (\hat{\pi}) | \theta)}{h (\Gamma^{-1} (\hat{\pi}) | \theta')} = \frac{h (\Gamma^{-1} (\hat{\pi}) | \theta)}{h (\Gamma^{-1} (\hat{\pi}) | \theta')},
\]

which is increasing in \( \Gamma^{-1} (\hat{\pi}) \) by the assumption that \( H (\pi | \theta) \) satisfies MLRP. Then the result follows from the fact that \( \Gamma^{-1} (\hat{\pi}) \) is an increasing function since \( \hat{\pi} = \Gamma (\pi) = \pi - T (\pi) \) is increasing.

Lemma 1 considers entrepreneurial profit tax schedules that involve marginal tax rates uniformly less than one, so that after-tax profits are increasing in before-tax profits. This is a weak restriction on tax policy that I assume to be satisfied in the following. The lemma shows that, under this condition, the fact that higher \( \theta \)-types have better before-tax profit distributions in the sense of the monotone likelihood ratio property translates into the same ordering of after-tax profit distributions. This is intuitive since such a profit tax preserves the ranking of before-tax profit levels and applies to all \( \theta \)-types equally. Combined with Theorem 1, Lemma 1 then implies that, whenever the government imposes a tax on entrepreneurial profits \( T (\pi) \) that involves marginal tax rates less than one, the resulting credit market equilibrium with this tax will be a single debt contract \( R_{z^*_T} (\hat{\pi}) = \min \{ \hat{\pi}, z^*_T \} \), where \( z^*_T \) is such that banks make zero profits in aggregate:

\[
\int_{\Theta} G (\hat{\phi}_{z^*_T, T} (\theta)) \left[ \int_{\Pi} \min \{ \pi - T (\pi), z^*_T \} dH (\pi | \theta) - I \right] dF (\theta) = 0. \tag{7}
\]

Here,

\[
\hat{\phi}_{z^*_T, T} (\theta) = \int_{\Pi} (\pi - T (\pi) - \min \{ \pi - T (\pi), z^*_T \}) dH (\pi | \theta) \tag{8}
\]

denotes the critical \( \phi \)-value for entry into entrepreneurship at \( \theta \) when the tax policy \( T (\pi) \) is in place.

Now suppose the government sets the profit tax schedule \( T (\pi) \) such that, for all \( \theta \in \Theta \),

\[
\int_{\Pi} T (\pi) dH (\pi | \theta) = - \left( \int_{\Pi} \min \{ \pi - T (\pi), z^*_T \} dH (\pi | \theta) - I \right) . \tag{9}
\]

Substituting equation (9) into (8) yields \( \hat{\phi}_{z^*_T, T} (\theta) = \hat{\phi}_e (\theta) \) for all \( \theta \), so that the policy is exactly counteracting the cross-subsidization in the credit market, providing the efficient incentives for entry into entrepreneurship to all agents.\(^7\) Note that equation (9) is a fixed point condition, since for any given profit tax schedule \( T (\pi) \), we can compute the equi-

\(^7\)From a bank’s perspective, of course, there is still cross-subsidization as net profits \( \int_{\Pi} \min \{ \pi - T (\pi), z^*_T \} dH (\pi | \theta) - I \) vary with \( \theta \).
librium debt contract \( z^*_T \) from solving equations (7) and (8), and given \( z^*_T \), the tax policy must satisfy equation (9). Total revenue from the profit tax is then given by

\[
\int_{\Theta} G(\tilde{\phi}_{z^*_T,T}(\theta)) \int_{\Pi} T(\pi) dH(\pi|\theta) dF(\theta) \\
= - \int_{\Theta} G(\tilde{\phi}_{z^*_T,T}(\theta)) \left( \int_{\Pi} \min\{\pi - T(\pi), z^*_T\} dH(\pi|\theta) - I \right) dF(\theta) = 0,
\]

where the first equality follows from equation (9) and the second from the zero profit condition (7). Hence, the government budget constraint is automatically satisfied with equality and the tax policy \( T(\pi) \) is feasible. The following proposition summarizes these results:

**Proposition 1.** Suppose that an entrepreneurial tax policy \( T(\pi) \) is introduced that is such that \( \pi - T(\pi) \) is increasing and equation (9) is satisfied for all \( \theta \in \Theta \). Then

(i) the resulting credit market equilibrium is such that \( \tilde{\phi}_{z^*_T,T}(\theta) = \tilde{\phi}_e(\theta) \) for all \( \theta \in \Theta \), where \( \tilde{\phi}_{z^*_T,T}(\theta) \) and \( \tilde{\phi}_e(\theta) \) are given by (8) and (5), respectively, and

(ii) the government budget is balanced.

By (9), the efficient entrepreneurial tax policy is regressive in the sense that higher ability entrepreneurs face a lower expected tax payment. In fact, for all \( \theta > \tilde{\theta}_T \) with \( \tilde{\theta}_T \) such that \( \int_{\Pi} \min\{\pi - T(\pi), z^*_T\} dH(\pi|\tilde{\theta}_T) = I \), the expected tax payment is negative. This is because the entrepreneurial tax has to counteract the equilibrium cross-subsidization in the credit market, which is decreasing in \( \theta \) as argued above. By the monotone likelihood ratio property of \( H(\pi|\theta) \), this pushes towards a tax schedule \( T(\pi) \) that is itself decreasing in \( \pi \) and in that sense regressive as well. This makes the assumption in Lemma 1 that \( \pi - T(\pi) \) is increasing even less restrictive, and will be further illustrated in the next section.

It is worth emphasizing that the entrepreneurial tax policy in Proposition 1 is quite different from the general subsidization of entrepreneurship that one may think of at first glance in view of credit market frictions. As shown by Ghatak, Morelli, and Sjöström (2007), even if there is only one-dimensional heterogeneity in entrepreneurial abilities, the resulting excessive entry into entrepreneurship in this case would require a lump sum tax on entrepreneurial profits, rather than a subsidy. Since the inefficiency with two-dimensional heterogeneity is more complicated, however, such a uniform tax turns out not to be optimal in general.

The policy also differs from the tax on bank profits that De Meza and Webb (1987) propose in order to deal with the excessive entry into entrepreneurship that they find in their model with one-dimensional heterogeneity. As can be seen from the zero profit condition
Thus, a tax on bank profits is not able (nor necessary) to restore occupational efficiency in the present setting. Instead, Proposition 1 points out the importance of entrepreneurial profit taxation as a more targeted corrective instrument. In particular, in contrast to the policies suggested in the literature, it is able to affect the composition of agents who become entrepreneurs rather than just the overall level of entrepreneurship in the economy, which is crucial in the present framework.

5 A Numerical Illustration

In this section, I provide a numerical example that illustrates the computation and properties of the corrective profit tax schedule. I consider $\theta \in [0, 1]$ where $F(\theta)$ is uniform. The entrepreneurial profit distributions are such that

$$h(\pi|\theta) = 2\frac{(1-\theta)\pi - \theta\pi - (1-2\theta)\pi}{(\pi - \pi)^2}, \forall \theta \in [0, 1], \pi \in [\pi, \pi],$$

which satisfies the MLRP property. The left panel in Figure 1 depicts the corresponding cdfs for a selection of four $\theta$-values. $\phi$ is assumed to follow a Pareto distribution with support $[0, \infty)$. I set $\Pi = [10, 20]$ and $I = 13$. Note that the conditions from the previous sections, including Assumption 1, are satisfied by this parametrization.

I start with computing the no tax equilibrium characterized in Theorem 1. This is done by finding the repayment level $z^*$ such that overall bank profits are zero, as required by equation (3), taking into account the endogenous occupational choice defined in equation (4). The right panel in Figure 1 plots aggregate profits as a function of $z \in [\pi, \pi]$. As can be seen from the graph, aggregate bank profits are increasing in $z$ and there is a unique value $z^* = 13.63$ such that they are zero.

I next compare the equilibrium occupational choice, described by the critical values $\tilde{\phi}_z(\theta)$, with the efficient occupational choice $\tilde{\phi}_e(\theta)$. Both functions are shown in the left panel of Figure 2. As shown in Corollary 1, the frontier for the equilibrium occupational choice is a clockwise rotation of the efficient frontier, i.e. the equilibrium involves too many low-skilled but too few high-skilled entrepreneurs, and vice versa for workers. This misallocation, however, is not reflected in the overall shares of entrepreneurs in the economy: They are given by 63.2% in the equilibrium and by 62.4% under the efficient occupational choice, and thus very close together in the two situations. This demonstrates how misleading it can be to look at the overall level of entrepreneurial activity as a measure of efficiency, rather than its composition as emphasized in this paper.
To compute the profit tax schedule that corrects this occupational misallocation, I follow an iterative procedure starting from the no tax equilibrium from Theorem 1. In particular, I start with $z_0 = z^*$ computed above and the initial tax schedule $T_0(\pi) = 0 \forall \pi \in \Pi$ and compute the right-hand side of equation (9). Then I find a new tax schedule $T_1(\pi)$ that satisfies condition (9), i.e.

$$\int\Pi T_1(\pi)dH(\pi|\theta) = -\left(\int\Pi \min\{\pi - T_0(\pi), z_0\}dH(\pi|\theta) - I\right) \forall \theta \in \Theta. \quad (10)$$

Given this new tax schedule $T_1(\pi)$, I find the new credit market equilibrium, as summarized by $z_1$ satisfying equations (7) and (8). Once $z_1$ has been found, it is used together with $T_1(\pi)$ to compute an updated value of the right-hand side of equation (10), and to find an updated tax schedule $T_2(\pi)$ that satisfies (10). These steps are repeated until a fixed point is reached. The constraint $T(\pi) \leq \pi$ is imposed in all steps.

The right panel of Figure 2 shows the resulting profit tax schedule $T(\pi)$, as well as before tax profits $\pi$ and after tax profits $\pi - T(\pi)$. By construction, the equilibrium with profit taxes $T(\pi)$ implements the efficient occupational choice $\bar{\phi}_e(\theta) \forall \theta \in \Theta$ and generates zero tax revenues. Moreover, the graph demonstrates that $T(\pi)$ is regressive and decreasing over most of the range of possible profit realizations. It taxes away almost all profits if they turn out to be very low, but on the other hand subsidizes high profit...
realizations. Clearly, after tax profits $\hat{\pi} = \pi - T(\pi)$ are increasing as a result and therefore the tax schedule is consistent with the assumption underlying Lemma 1. They now range from 0 to 49.97, and new equilibrium repayment level consequently increases to $z^*_T = 20.73$. This illustrates that the credit market equilibrium, not just the occupational choice, is significantly affected by the entrepreneurial tax policy.

6 Extensions

The purpose of this section is to demonstrate how the results derived so far are affected in a richer environment that allows for redistributive taxes on the labor income of workers. I therefore explicitly include endogenous labor supply and labor markets into the model considered so far and demonstrate that the results are unchanged by this generalization. I then use this extension to discuss the effect of redistribution among workers on profit taxation and point out that what matters for implementing the efficient occupational choice is that the profit tax is regressive relative to redistributive taxes on labor income. I argue that this provides a justification for a pattern observed in many countries, namely that taxes on entrepreneurs and businesses are less progressive than labor income taxes.
6.1 Labor Market Equilibrium

Let me briefly demonstrate how to include labor markets into the present framework. This extension is necessary in order to address taxes on labor income since, in the model so far, a worker’s payoff $\phi$ was assumed to be private information, ruling out incentive compatible redistribution among workers. I show in the following that the model equivalently applies to the standard optimal taxation framework where $\phi$ is a worker’s unobservable skill, but labor income is observable.

Formally, suppose that workers supply labor $l$ and obtain utility $w\phi l - h(l)$, where $w$ is the wage and thus $w\phi$ is the effective wage of a worker of skill $\phi$, and $h(l)$ is some increasing and convex disutility of labor. For any given wage $w$, workers then supply labor $l_w(\phi)$ optimally and obtain indirect utility $V_w(\phi)$, which is strictly increasing in $\phi$. Entrepreneurs, on the other hand, hire an amount of labor $L$ and, after having made the fixed investment $I$, produce output using some concave technology $Y(L)$. Their profits are given by $\pi = Y(L) - wL + \varepsilon$, where $\varepsilon$ is some stochastic profit component distributed according to the cdf $H_\varepsilon(\varepsilon|\theta)$. Observe that this implies that, for any given set of credit contracts $\{R_\theta(\pi)\}$, all entrepreneurs hire the same amount of labor such that $Y'(L) = w$. Hence, if $H_\varepsilon$ satisfies the monotone likelihood ratio property, for any wage $w$ I can work directly with the resulting distribution of profits $\pi \sim H_w(\pi|\theta)$, with the only difference that it is now a function of $w$.

For any given wage $w$, the model therefore works exactly as before when replacing $H(\pi|\theta)$ by $H_w(\pi|\theta)$ and $\phi$ by $V_w(\phi)$. In particular, for a given $w$, the credit market equilibrium is defined as in Definition 1, where the critical value for occupational choice $\tilde{\phi}_w(\theta)$ now solves

$$V_w(\phi) = \int_{\pi} (\pi - R_\theta(\pi)) dH_w(\pi|\theta) \quad (11)$$

for all $\theta \in \Theta$. Given the cross-subsidization in the credit market equilibrium, there is thus the same occupational misallocation and the same structure of corrective profit taxation as discussed in Section 4 for any given wage. To see this, observe that the equilibrium occupational choice under the tax schedule $T(\pi)$ and given the wage $w$ will now be determined by the critical value

$$\tilde{\phi}^{z^*_T,T,w}_{z^*_T}(\theta) = V^{-1}_w \left( \int_{\Pi} (\pi - T(\pi) - \min\{\pi - T(\pi), z^*_T\}) dH_w(\pi|\theta) \right)$$

whereas the efficient critical value would be

$$\tilde{\phi}^{e,w}_w(\theta) = V^{-1}_w \left( \int_{\Pi} \pi dH_w(\pi|\theta) - I \right), \quad (12)$$
so that setting $T(\pi)$ as required by (9) still implements $\bar{\phi}_{Z^T,T}(\theta) = \bar{\phi}_{\epsilon,T}(\theta)$ for all $\theta \in \Theta$. In particular, this also holds for the equilibrium wage $w^*$, which is such that the labor market clears, i.e.

$$\int_{\Theta} G_\theta(\bar{\phi}(\theta)) L(w^*) dF(\theta) = \int_{\Theta} \int_{\bar{\phi}(\theta)} \phi_\theta(\phi) l_w(\phi) dF(\theta),$$

where $L(w^*)$ solves $Y'(L) = w^*$. This demonstrates that the previous results can be extended to this more general framework with endogenous labor supply in a straightforward way.\(^9\) Notably, since the analysis can be performed for any given wage $w$, let me suppress dependence on $w$ in the following to simplify notation.

### 6.2 Relative Degrees of Cross-Subsidization and Regressivity

Let me now consider the case of progressive redistribution among workers, as for instance implemented by some progressive income tax $T_y(y)$ with $y \equiv w\phi l$, so that workers no longer obtain utility $V(\phi)$ as in the preceding subsection but instead some increasing but concave transformation $\Psi(V(\phi))$ of it, where $\Psi$ is such that there is some $V^*$ with

$$\Psi(V) \geq V \text{ for all } V \leq V^* \text{ and } \Psi(V) \leq V \text{ otherwise.} \quad (13)$$

Condition (13), which is assumed for the sake of clarity, captures the notion of progressive redistribution in the sense that low ability workers, with low $V(\phi)$ in the no tax equilibrium, benefit from an increase in utility and vice versa for high ability workers. By equation (11), the equilibrium occupational choice is now determined by the critical value

$$\bar{\phi}_{Z^T,T}(\theta) = V^{-1} \left( \Psi^{-1} \left( \int_{\Pi} (\pi - T(\pi) - \min\{\pi - T(\pi), z^+_T\}) dH(\pi|\theta) \right) \right), \quad (14)$$

whereas the efficient one is still given by (12). The following proposition provides a decomposition of the corrective profit tax in this case.

**Proposition 2.** Suppose workers obtain utility $\Psi(V(\phi))$, where both $\Psi(V)$ and $V(\phi)$ are increasing. If the entrepreneurial profit tax $T(\pi)$ is such that

(i) $\pi - T(\pi)$ is increasing in $\pi$ and

---

\(^9\)See Ghatak, Morelli, and Sjöström (2007) and Scheuer (2011) for an analysis of entrepreneurial taxation in view of general equilibrium effects through wages.
\begin{align}
\int_{\Pi} T(\pi) dH(\pi|\theta) = - \left( \int_{\Pi} \min\{\pi - T(\pi), z^*_T\} dH(\pi|\theta) - I \right) + \left( V(\hat{\phi}_e(\theta)) - \Psi(V(\hat{\phi}_e(\theta))) \right) \tag{15}
\end{align}

for all $\theta \in \Theta$, then it implements the efficient occupational choice with $\hat{\phi}_{z^*, T}(\theta) = \hat{\phi}_e(\theta)$ for all $\theta \in \Theta$.

Proof. Equalizing the left-hand sides of equations (12) and (14) yields, after applying first $V(\phi)$ and then $\Psi(V)$ on both sides of the equation and rearranging,

\begin{align*}
\int_{\Pi} T(\pi) dH(\pi|\theta) &= - \left( \int_{\Pi} \min\{\pi - T(\pi), z^*_T\} dH(\pi|\theta) - I \right) \\
&\quad + \int_{\Pi} \pi dH(\pi|\theta) - I - \Psi \left( \int_{\Pi} \pi dH(\pi|\theta) - I \right).
\end{align*}

Next, using equation (12), the second line above can be rewritten as

\begin{align*}
V(\hat{\phi}_e(\theta)) - \Psi(V(\hat{\phi}_e(\theta))),
\end{align*}

which leads to (15). \qed

The first term in (15) is familiar from equation (9) in Section 4, requiring the profit tax to counteract cross-subsidization in the credit market. The second term, however, is new and captures the effects of redistribution among workers on occupational choice. In particular, it is negative for all $\theta \leq \theta^*$ and positive otherwise under condition (13), with $\theta^*$ such that $V(\hat{\phi}_e(\theta^*)) = V^*$. This new component of the profit tax therefore goes in the opposite direction as the first and familiar component and makes the profit tax less regressive than if there was no redistribution among workers. The reason is that progressive redistribution among workers by itself induces an occupational choice with too many low-skilled and too few high-skilled workers (in terms of $\phi$). This may partly undo or even cancel out the opposite occupational misallocation resulting from cross-subsidization in the credit market.

Proposition 2 gives rise to the following two key insights from this model extension. First, progressive redistribution among workers is an alternative policy tool to deal with occupational choice distortions from cross-subsidization in credit markets. Rather than counteracting this cross-subsidization directly through profit taxes, it introduces a symmetric cross-subsidization among workers to restore the efficient occupational choice. In fact, one may construct a progressive labor income tax $T_y(y)$, inducing a transformation $\Psi(V)$, such that the first and second term on the right-hand side of equation (15) just cancel when $T(\pi) = 0$ for all $\pi \in \Pi$. 

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Second, it demonstrates that the efficient occupational choice can be implemented by a continuum of tax policies, ranging from a regressive profit tax together with a flat tax on labor income, to the other extreme of a progressive labor income tax and a flat profit tax. What matters in all of those implementations is that the profit tax is always regressive relative to the labor income tax schedule (or equivalently, that it is less progressive than redistribution among workers). This is particularly evident from the decomposition in equation (15), where the second term matches the progressivity of redistribution among workers, whereas the first term captures the additional regressive component in profit taxes that was studied in isolation in Section 4. It also describes a pattern that can frequently be observed in practice. Indeed, entrepreneurial or business taxes are less progressive than labor income taxes in most countries. The present paper points at the role of adverse selection in credit markets as a novel justification for this structure of policy. At the most general level, the above results indicate that, in an economy with different occupations that are affected by cross-subsidization to different degrees, occupations for which there is more cross-subsidization should face relatively more regressive, or less progressive, tax schedules.

7 Conclusion

This paper has analyzed the non-linear taxation of profits in a private information economy with endogenous firm formation. I have pointed out that a differential tax treatment of profits can be justified based on corrective arguments, mitigating occupational misallocation that results from credit market frictions. More generally, the role of tax policies that are able to affect the mix of individuals entering into entrepreneurship, rather than only the aggregate number of entrepreneurs, has been emphasized. This is because in a setting with multidimensional heterogeneity, the overall level of entrepreneurial activity is no longer a sufficient statistic for the efficiency of occupational choice.

Even though the proposed framework provides an efficiency based justification for the observed pattern that business taxes are typically less progressive than labor income taxes, the analysis has abstracted from several potentially important aspects of entrepreneurship and its implications for tax policy. Notably, income effects and risk aversion, capital accumulation and additional choices available to entrepreneurs, such as the decision whether to incorporate or not, have been neglected in this paper. An exploration of how some of these issues may affect the properties of optimal policy is left for future research.
References


A Proof of Theorem 1

By construction, the proposed equilibrium contract $R_{z^*}(\pi)$ satisfies conditions (i) and (ii) of Definition 1, and thus only requirement (iii) remains to be checked. I will do so by proving a series of lemmas, starting with the following result due to Innes (1993).

**Lemma 2.** Consider an arbitrary non-debt contract $R(\pi)$ that satisfies the limited liability and monotonicity constraints, and let $R_{z^*}(\pi) \equiv \min\{\pi, z_0\}$ denote the debt contract such that

$$\int_{\Pi} R(\pi) dH(\pi|\theta) = \int_{\Pi} R_{z^*}(\pi) dH(\pi|\theta)$$

for some $\theta \in \Theta$. Then

$$\int_{\Pi} R(\pi) dH(\pi|\theta') \leq \int_{\Pi} R_{z^*}(\pi) dH(\pi|\theta') \quad \forall \theta' \leq \theta.$$

In words, whenever banks offer a debt contract $R_{z^*}(\pi)$ that involves the same expected repayment for entrepreneurs of ability $\theta$ as the non-debt contract $R(\pi)$, then the expected repayment from the debt contract $R_{z^*}(\pi)$ is at least as high as from the non-debt contract $R(\pi)$ for all entrepreneurs of a lower skill $\theta' \leq \theta$. This result immediately follows from the fact that the entrepreneurs’ profit distributions are ranked by MLRP and that, among the contracts that satisfy the limited liability and monotonicity constraints, debt contracts put the maximal repayment in low profit states. Note that Lemma 2 also immediately implies

$$\int_{\Pi} [\pi - R(\pi)] dH(\pi|\theta') \geq \int_{\Pi} [\pi - R_{z^*}(\pi)] dH(\pi|\theta') \quad \forall \theta' \leq \theta,$$
i.e. all entrepreneurs of quality less than \( \theta \) prefer the non-debt contract \( R(\pi) \) to the debt contract \( R_{\theta}(\pi) \). Clearly, this is independent of the type dimension \( \phi \).

Suppose that, in the presence of the equilibrium contract \( R_{z^*}(\pi) \), a bank offers an arbitrary, incentive compatible set of deviation contracts \( \{ R_{\theta}^{d}(\pi) \} \). Let me denote the resulting critical cost values for occupational choice by \( \tilde{\phi}_d(\theta) \), i.e. for all \( \theta \in \Theta \),

\[
\tilde{\phi}_d(\theta) = \max \left\{ \int_{\Pi} [\pi - R_{z^*}(\pi)] dH(\pi|\theta), \int_{\Pi} [\pi - R_{\theta}^{d}(\pi)] dH(\pi|\theta) \right\}.
\]  

(16)

Next, the following auxiliary result is useful.

**Lemma 3.** For all \( \theta \in \Theta \), let \( \Delta \tilde{\phi}(\theta) \equiv \tilde{\phi}_d(\theta) - \tilde{\phi}_{z^*}(\theta) \) denote the change in critical cost values for occupational choice due to the deviation. Then \( \Delta \tilde{\phi}(\theta) \) is decreasing in \( \theta \).

**Proof.** Showing that \( \Delta \tilde{\phi}(\theta) \equiv \tilde{\phi}_d(\theta) - \tilde{\phi}_{z^*}(\theta) \) is decreasing in \( \theta \) is, by (4) and (16), equivalent to showing that

\[
\int_{\Pi} R_{\theta}^{d}(\pi) dH(\pi|\theta) - \int_{\Pi} R_{z^*}(\pi) dH(\pi|\theta)
\]

is increasing in \( \theta \). To see this, note that, by Lemma 2, if \( \int_{\Pi} R_{\theta}^{d}(\pi) dH(\pi|\theta) = \int_{\Pi} R_{z^*}(\pi) dH(\pi|\theta) \) for some \( \theta \), then \( \int_{\Pi} R_{\theta}^{d}(\pi) dH(\pi|\theta') \leq \int_{\Pi} R_{z^*}(\pi) dH(\pi|\theta') \) for all \( \theta' \leq \theta \), which implies that

\[
\int_{\Pi} R_{\theta}^{d}(\pi) dH(\pi|\theta) - \int_{\Pi} R_{z^*}(\pi) dH(\pi|\theta) \geq \int_{\Pi} R_{\theta}^{d}(\pi) dH(\pi|\theta') - \int_{\Pi} R_{z^*}(\pi) dH(\pi|\theta')
\]

(17)

whenever \( \theta \geq \theta' \). Moreover, by incentive compatibility of \( \{ R_{\theta}^{d}(\pi) \} \),

\[
\int_{\Pi} [\pi - R_{\theta}^{d}(\pi)] dH(\pi|\theta') \geq \int_{\Pi} [\pi - R_{\theta}^{d}(\pi)] dH(\pi|\theta')
\]

and hence \( \int_{\Pi} R_{\theta}^{d}(\pi) dH(\pi|\theta') \leq \int_{\Pi} R_{\theta}^{d}(\pi) dH(\pi|\theta') \), which, when combined with (17), completes the argument.

This allows me to prove the following lemma:

**Lemma 4.** Let \( \Delta G(\theta) \equiv G(\tilde{\phi}_d(\theta)) - G(\tilde{\phi}_{z^*}(\theta)) \) for all \( \theta \in \Theta \). Under Assumption 1, \( \Delta G(\theta) \) is decreasing in \( \theta \).

**Proof.** First, observe that \( \tilde{\phi}_{z^*}(\theta) \) is increasing in \( \theta \) by MLRP. Moreover, \( G(\phi) \) is concave by Assumption 1. Therefore, the result from Lemma 3 that \( \Delta \tilde{\phi}(\theta) \equiv \tilde{\phi}_d(\theta) - \tilde{\phi}_{z^*}(\theta) \) is decreasing in \( \theta \) implies that

\[
\Delta G(\theta) \equiv G(\tilde{\phi}_d(\theta)) - G(\tilde{\phi}_{z^*}(\theta))
\]

is also decreasing in \( \theta \), proving the lemma.
The deviating bank’s expected profits from offering \(\{R^d_d(\tau)\}\) are given by

\[
\Pi^d = \int_\Theta 1_{\{\hat{\phi}_d({\theta}) > \hat{\phi}_z({\theta})\}}({\theta})G(\hat{\phi}_d({\theta})) \int_{\Pi} (R^d_d(\tau) - I) dH(\pi|\theta)dF(\theta)
\]

\[
< \int_\Theta 1_{\{\hat{\phi}_d({\theta}) > \hat{\phi}_z({\theta})\}}({\theta})G(\hat{\phi}_d({\theta})) \int_{\Pi} (R^z_z(\tau) - I) dH(\pi|\theta)dF(\theta)
\]

since \(\int_\Pi R^d_d(\tau)dH(\pi|\theta) < \int_\Pi R^z_z(\tau)dH(\pi|\theta)\) whenever \(\hat{\phi}_d({\theta}) > \hat{\phi}_z({\theta})\) by (16). Aggregate profits in the proposed equilibrium are

\[
\Pi^* = \int_\Theta G(\hat{\phi}_z({\theta})) \int_{\Pi} (R^z_z(\tau) - I) dH(\pi|\theta)dF(\theta) = 0
\]

by (3), and therefore, subtracting (19) from (18) yields

\[
\Pi^d < \int_\Theta 1_{\{\hat{\phi}_d({\theta}) > \hat{\phi}_z({\theta})\}}({\theta})G(\hat{\phi}_d({\theta})) - G_z_z(\hat{\phi}({\theta})) \int_{\Pi} (R^z_z(\tau) - I) dH(\pi|\theta)dF(\theta)
\]

\[
= \int_\Theta (\Delta G({\theta}) - 1_{\{\hat{\phi}_d({\theta}) = \hat{\phi}_z({\theta})\}}({\theta})G(\hat{\phi}_z({\theta})) \int_{\Pi} (R^z_z(\tau) - I) dH(\pi|\theta)dF(\theta)
\]

The following two lemmas establish that the RHS of (20) is non-positive.

**Lemma 5.** In equation (20),

\[
\int_\Theta \Delta G({\theta}) \int_{\Pi} (R^z_z(\tau) - I) dH(\pi|\theta)dF(\theta) \leq 0.
\]

**Proof.** Find \(\hat{\theta}\) such that \(\int_{\Pi} (R^z_z(\tau) - I) dH(\pi|\hat{\theta}) = 0\), which exists and is unique by (3) and MLRP. Also, find the constant \(\delta\) such that \(\delta G(\hat{\phi}_z(\hat{\theta})) = \Delta G(\hat{\theta})\). Then since \(\Delta G({\theta})\) is decreasing and \(\delta G(\hat{\phi}_z(\hat{\theta}))\) is increasing by Lemma 4, \(\delta G(\hat{\phi}_z(\hat{\theta})) \leq \Delta G(\hat{\theta})\) for all \(\theta \leq \hat{\theta}\), and \(\delta G(\hat{\phi}_z(\hat{\theta})) \geq \Delta G(\hat{\theta})\) otherwise. Thus,

\[
\int_{\hat{\theta}}^{\hat{\theta}} \Delta G({\theta}) \int_{\Pi} (R^z_z(\tau) - I) dH(\pi|\theta)dF(\theta) + \int_{\hat{\theta}}^{\hat{\theta}} \Delta G({\theta}) \int_{\Pi} (R^z_z(\tau) - I) dH(\pi|\theta)dF(\theta)
\]

\[
\leq \int_{\hat{\theta}}^{\hat{\theta}} \delta G(\hat{\phi}_z(\hat{\theta})) \int_{\Pi} (R^z_z(\tau) - I) dH(\pi|\theta)dF(\theta) + \int_{\hat{\theta}}^{\hat{\theta}} \delta G(\hat{\phi}_z(\hat{\theta})) \int_{\Pi} (R^z_z(\tau) - I) dH(\pi|\theta)dF(\theta)
\]

\[
= 0,
\]

where the inequality follows from \(\int_{\Pi} (R^z_z(\tau) - I) dH(\pi|\theta) < 0\) for \(\theta \leq \bar{\theta}\) and \(\int_{\Pi} (R^z_z(\tau) - I) dH(\pi|\theta) \geq 0\) otherwise, and the equality from (3). \(\square\)

**Lemma 6.** In equation (20),

\[
\int_\Theta 1_{\{\hat{\phi}_d({\theta}) = \hat{\phi}_z(\hat{\theta})\}}({\theta})G(\hat{\phi}_z(\hat{\theta})) \int_{\Pi} (R^z_z(\tau) - I) dH(\pi|\theta)dF(\theta) \geq 0.
\]

**Proof.** There are 3 cases to be considered. If \(\hat{\phi}_d({\theta}) = \hat{\phi}_z(\hat{\theta})\) for all \(\theta \in \Theta\) then (23) holds with equality due to (3). If there does not exist a \(\theta \in \Theta\) such that \(\hat{\phi}_d({\theta}) = \hat{\phi}_z(\hat{\theta})\), then (23) also holds
as an equality trivially. Finally, if $\tilde{\phi}_d(\theta) = \tilde{\phi}_{z^*}(\theta)$ holds for some but not all $\theta \in \Theta$, there must exist some threshold value $\hat{\theta} \in (\underline{\theta}, \overline{\theta})$ such that $\tilde{\phi}_d(\theta) > \tilde{\phi}_{z^*}(\theta)$ for all $\theta < \hat{\theta}$ and $\tilde{\phi}_d(\theta) = \tilde{\phi}_{z^*}(\theta)$ otherwise. This follows from Lemma 3, which has shown that $\Delta \tilde{\phi}(\theta)$ is decreasing in $\theta$ and, by the definition in (16), $\tilde{\phi}_d(\theta) \geq \tilde{\phi}_{z^*}(\theta)$. With this, (23) becomes

$$\int_{\hat{\theta}}^{\overline{\theta}} G(\tilde{\phi}_{z^*}(\theta)) \int_{\Pi} (R_{z^*}(\pi) - I) dH(\pi|\theta) dF(\theta) > 0$$

since $\hat{\theta} > \theta$ and $\int_{\Pi} (R_{z^*}(\pi) - I) dH(\pi|\theta)$ is increasing in $\theta$ by MLRP.

Lemmas 5 and 6 together with equation (20) show that $\Pi^d < 0$, and hence there does not exist a profitable deviation.